FLAVOUR PROFILES OF LOIN CUTS AS INFLUECEND BY AGE CLASSIFICATION, NUTRITIONAL BACKGROUND AND POST-MORTEM AGING

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Abstract – MEATCO, Namibia exports extensively aged loin to South Africa and Europe that originates from cattle of varying ages and kept under different feeding regimes (grain fed vs pasture) as a single product line. Age, feeding regime and aging can all affect flavour which is an important part of the consumers eating experience. This study investigates the effect of these factors on eating quality by means of sensory evaluation. Six age groups/feeding scenarios namely, pasture finished AF (0 tooth), ABF (1-2 teeth), B-4 teeth and B-6 teeth and feedlot finished AG (0 tooth), ABG (1-2 teeth) were defined. Within each age/feeding scenario two post-mortem aging groups (36 and 55 days) were specified. A trained taste panel could distinguish a difference in flavours between different age groups and feeding regimes. It can therefore be concluded that the inclusion of these different age/feeding regimes into a single product line could affect the consumers eating experience, with their preference based on previous experience with grain vs pasture fed meat.

Key Words – BEEF flavours, feeding regime, Eating quality

I. INTRODUCTION

The Meat Corporation of Namibia (MEATCO) export extensively aged (36-55days) loin to South Africa and Europe that originates from cattle of ages varying from 2 years and less (A age- 0 tooth) to 4 years (B age- 4 to 6 teeth) and kept under different feeding regimes (grain fed vs pasture) as a single product line. Tenderness is internationally accepted as the most important attribute for consumer satisfaction, but flavour (as well as atypical flavours) also plays a major role in ultimate consumer satisfaction.

Pasture feeding most often implies older animals than grain fed animals and this alone can affect flavour. With regard to typical beef flavour, Smith *et al.* [1] found a negative correlation between carcass maturity (age of the animal) and flavour desirability and Jeremiah [2] reported that flavour preference deteriorates (becomes less desirable) with an increase in age of the animal, and at the same time strength of the flavour increases. Feeding regime by itself also affects palatability traits like aroma, flavour and off-flavour. Lipids are a storehouse for aromatic compounds which are released when chemical changes occur during heating [3]. Most of the 'off-flavour' overtones relate to deposition of compounds (from feed source) into the fat component of the animal system [4]. It must be pointed out though that the consumers experience will affect their preference in taste. Sanudo *et al.* [5] illustrated that preference goes hand in hand with experience and that atypical flavours are not necessarily "bad" flavours or odours, just flavours that the consumer is not used to (if you are used to grain fed animals then pasture animal flavours may come across as strong or strange). Aging may or may not have an effect on flavour with some reports showing that aging time did not influence flavour [6], while others found that "beefy flavour" develops from day 1 and reaches an optimum and deteriorates as longer aging times enhance off-flavours [7].

The interactive effect of age, type of diet (grass vs grain) and the effect of extended post-mortem aging could influence sensory properties such as flavour to different degrees. Therefore combining age groups into a single product line could have an effect on the eating experience of the consumer and may increase the risk of customer complaints. This study investigates the effect of age, feeding regime and post-mortem aging duration on sensory evaluation of various flavour overtones.

II. MATERIALS AND METHODS

Six age groups/feeding scenarios namely, pasture finished AF (0 tooth), ABF (1-2 teeth), B-4 teeth and B-6 teeth and feedlot finished AG (0 tooth),

ABG (1-2 teeth) were defined. Within each age/feeding scenario two post-mortem aging groups (36 and 55 days) were specified. The loin (consisting of *m. longissimus lumborum*) was sampled from the same area on the carcass from the left side for 36 days aging and from the right side for 55 days aging.

Samples were frozen and processed into 30mm steaks, vacuum packed and thawed at 3°C for 24h before preparation. Thawed steaks were prepared according to an oven-broiling method using direct radiant heat [8]. An electric oven was set on "broil" 10min prior to preparation (200°C). Steaks were cooked to an internal temperature of 70°C. Wrapped, coded samples were presented to a ten member trained panel to evaluate the following: "*Roasted flavour*" (identification of caramelized browned fat flavor tones), "*Metallic/livery/bloody*" (identification of metallic, livery or bloody taste typical of extendedly aged products), "*Rancid*" (identification of rancid, soapy or fatty off-flavour tones), "*Animal-like"* (identification of musty, earthy, barnyard or sweaty flavor tones), "*Sour"* (Identification of a sour flavour as experienced in extendedly aged products) and "*Pasture-like*" or "*Green*" (identification of grassy or shrubby flavor tones). Panelists scored 8 for high intensities and 1 for extreme blandness or absence of an attribute.

Excel 2010 with add-on software XLSTAT was used to perform multivariate analyses (PCA) and draw frequency distributions for sensory scores [9].

III. RESULTS AND DISCUSSION

Fig. 1 shows the frequencies of the 6 flavour attributes of 6 age/feeding regime groups, i.e. shows the number of times expressed as a percentage (not the intensity) that any of these flavour attributes were scored (≥2) by the panellists. *Roasted* flavour, *Rancid*, *Animal-like*, *Pasture-like* or *Green* were most affected by diet and age. *Roasted* flavour was more often recorded for the 2 grain fed groups (AG and ABG) and the young pasture finished group (AF) in the loin. The opposite was found for *Rancidity* or fatty off-flavours, where older pasture finished animals were recorded more frequently. *Animal-like* overtones were experienced more often and more intensely in older pasture animals (ABF, B4 and

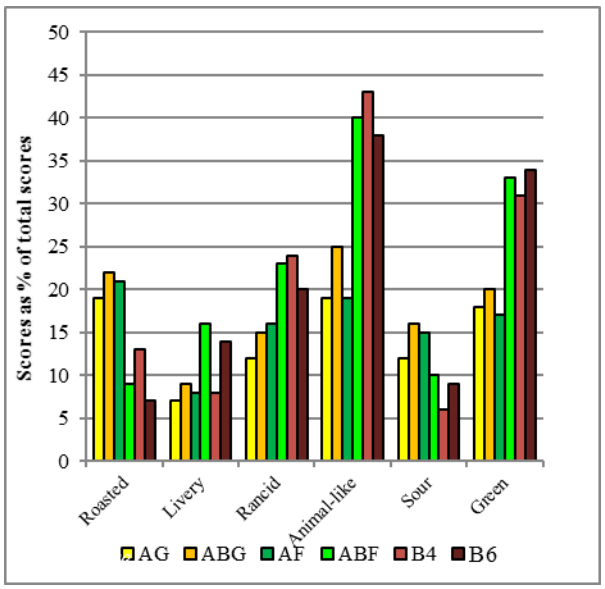

Figure 1. Frequencies of detecting different flavour overtones of the loins of different age groups and feeding regimes (% of total scores)

B6) than in AG, ABG and AF. Generally the same pattern was found for *Pasture-like* or *Green* overtones.

The work of Vasta *et al.* [10] , Enser *et al.* [11], Wood *et al.* [12] and others generally attribute the differences between pasture finished groups and grain fed groups to differences in fatty acid composition, although the effect of other flavour components are not excluded. We may speculate that rancidity in pasture finished samples was the result of high levels of unsaturated fatty acids that were oxidized during storage, however, Spanier *et al.* [13] reported that off-flavours develop when lipid oxidation takes place forming free-radicals that interact with other flavour constituents, although this effect will be limited with normal vacuum aging. However, considering the long duration of aging in the project and partial oxygen permeability of the bags, development of rancidity cannot be ruled out. High rancidity scores may also have been due to panelists' perception of atypical fatty flavours of free range animals as rancid or negative flavours. Furthermore high scores for *Pasture-like* and *Animal-like* flavours would have been associated with high levels of alpha-linolenic and other n-3 polyunsaturated fatty acids in grass fed cattle, in particular older cattle, while the effect of these compounds were

probably not as pronounced in younger pasture finished cattle due to shorter feeding periods on grass [12]. Higher levels of oleic and linoleic acid in grain fed cattle would explain the higher scores for roasted flavours.

Flavour scores for *Metallic*, *Livery* and *Bloody* overtones were generally not recorded very often and were slightly higher for ABF and B6. These overtones are typical of long aged samples and probably not related to age of the animal according to Yancey *et al.* [14]. *Sourness* was also not recorded often but AG, ABG and AF were more often scored compared to older pasture finished samples (ABF, B4 and B6). The coupling of amino acids with organic acids gives rise to the sour flavour in meat according to MacLeod [15]. It is possible that grain fed cattle had higher muscle energy levels and produced more lactic acid during rigor mortis to produce more acid like flavour overtones than the pasture finished cattle.

Mean values and standard deviations suggest that aging between 36 and 55 days did not change the flavour perception significantly (results not shown). A plausible explanation could be that most changes have taken effect by 36 days.

We used multivariate statistics (Principal Component Analyses, PCA) to summarise our results on sensory analyses of flavour overtones. On each level a certain percentage of the variation among groups is explained, e.g. the horizontal display (distances and directions of attributes and treatment groups) explains 67.14% of the variation and the vertical display explains 12.21 % of the variation.

In Fig. 2 all AG, ABG and AF groups (both 36 and 55 days aging times) are on the right and all ABF, B4 and B6 groups on the opposite side with B6 more or less the farthest from the centre – all on the horizontal level. This means that the younger pasture finished group and both grain fed groups separate from the older pasture finished groups. Considering the distance and direction of the different sensory attributes, the horizontal placement of attributes explains most

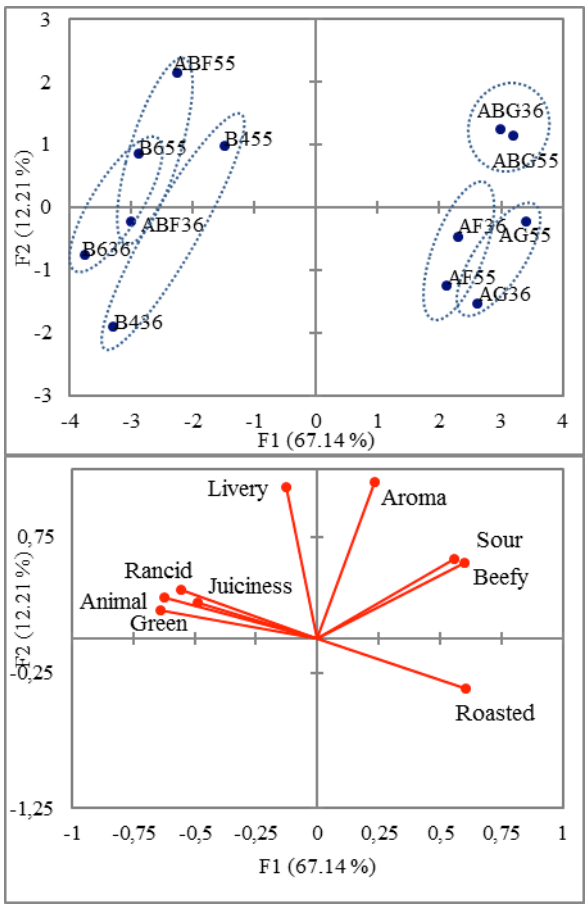

Figure 2. Principal component analyses: Biplots showing scores (treatment groups) and loadings (attributes) for the two first components F_1 and F_2: (explaining 79.34% of variation among treatment groups)

of the variation (67.14%) and is therefore the most important.

We may therefore conclude that the 3 younger groups separate from the 3 older groups because of more frequent scores for *Roasted* and *Sour* flavour overtones. In contrast *Rancid*, *Animal-like* and *Green* were scored less frequently for the grain fed and young pasture groups while the older groups on the left were scored more frequently for these attributes. While the 2 post-mortem aging groups for each age group were mostly grouped together on a horizontal level, it is noteworthy that B4 36 days lies further away from the centre than B4 55 days, meaning that the different attributes, as explained earlier, were more pronounced for B4 36 days. However of more importance are the general locations of the 6 main age/feeding regime groups relative to the

centre. On the vertical level *Livery* flavour overtones had a strong positive direction and distance, meaning that we would expect B4 36 days, AF 36 days and AG 36 days to have lower scores for this attribute and ABF 55 days to show higher scores. However, we need to keep in mind that this level contributed less to the variation among groups (only 12.21 %).

IV. CONCLUSION

Animal-like and *pasture-like* overtones, and in some cases *rancidity* were more pronounced in ABF, B4 and B6 than in AF, AG and ABG. In contrast the 2 grain fed groups and AF tended to show more frequent scores for roasted fat flavour and sourness. Consumers may distinguish a difference in flavours between different age groups and feeding regimes and this may influence their eating satisfaction, with their preference based on previous experience with grain vs. pasture fed meat.

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